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CONTENTS

DEVELOPMENT OF TURBIDIMETRIC STANDARDS AND TESTS OF TURBIDIMETERS FOR OIL-IN-WATER EMULSIONS

The steam condensates from the reciprocating engines of small aircraft carriers and transports contain some of the lubricating oil in the form of an emulsion. This oil must be removed by filters before the water can be used again in the ship's boilers. Consequently, turbidimeters and turbidity standards are needed for determining the amount of emulsified oil in the steam condensates and clarified filtrates.

At the request of the Research Section of the Navy Bureau of Ships, George G. Manov, N. J. DeLollis, and S. F. Acree, of the National Bureau of Standards, undertook in May 1943 the development and production of standards of turbidity for oil-in-water emulsions ranging from 0 to 2 parts per million of oil (ppm) that would deteriorate as little as possible during a 6-month period. It was further requested that an effort be made to stimulate the development and production of shipboard turbidimeters by manufacturers, and that the resulting instruments be tested at the Bureau for compliance with performance specifications set up jointly by the Bureau of Ships and the National Bureau of Standards.

Six commercial and laboratory type turbidimeters were tested as to suitability for use on board rolling, vibrating ships under the conditions of high temperatures and humidities usually present in the engine rooms. Turbidimeters with photocells and galvanometer or "magic-eye" balance detectors were studied, and calibrated with various turbidity standards. In the most successful instrument two opposing photocells are used to measure the difference in light transmission of air and of turbidity standards or of a cuvette containing the test sample. A "magic-eye" tube serves to detect the balance point. The meter is rugged, portable, and plugs into any 110-v a-c line for operation. It is insensitive to tilting, vibration, and shock, and may be calibrated readily by any of the types of standards developed at the Bureau. The readings of the instrument are reproducible to ± 0.05 ppm of oil, and the steadiness appears to be quite satisfactory. The calibration of the scale, which can be graduated to read directly in parts per million, is linear and does not shift with time. Likewise, a humidity of 100 percent does not affect the operation of the electric circuits of the turbidimeter.

[1] Published with approval of the Director of the Budget.

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Three types of turbidity standards that can be turned out by mass-production methods have been developed. The first consists of films of gelatin in which colloidal carbon is dispersed uniformly in amounts giving decreased transmittancies corresponding to 0.6, 1.6, 1.7, and 2.3 ppm of oil. These films are cemented with Canada balsam between borosilicate glass sheets.

In the second type, rectangular blocks of crown borosilicate glass, with four 25 by 40-mm faces, A, B, C, and D, were polished to give graded light transmittancies. In the standardization, incident light strikes face B, passes through the 40-mm length of glass, through face A, and then to a photocell. Face A is more highly polished than face B, and the combination gives about 91 percent light transmission—equivalent to that of distilled water (0.0 ppm of oil) in a rectangular glass cuvette with the same light path. By rotating the block 180° so that face B is nearest the photocell, the calibration corresponds approximately to 0.3 ppm of emulsified oil in the same cuvette. Faces C and D are slightly rougher than faces A and B. The calibrations of the four faces, as above, are linear and correspond to approximately 0.0, 0.3, 0.7, and 1.5 ppm of oil in the cuvettes in two types of turbidimeters. These glass standards were produced in the Bureau's optical shop with satisfactory tolerances.

The third type of turbidity standard consists of colloidal carbon (India ink) in a 0.5-percent solution of Aerosol as dispersing agent, together with 0.1-percent of orthochlorophenol as a preservative, and 0.002-molal phosphate buffer (pH 7). Accelerated aging tests at 140° F showed that these carbon standards are reasonably stable, whereas the oil emulsion standards used for calibrations change slowly and must be made up again at intervals.

EFFECT OF SODIUM CHLORIDE ON BUFFER MIXTURES

For determining precise pH values from electromotive-force measursements with chloride electrodes, sodium chloride must be added to the buffer mixtures. When standard buffers of known acidity are used for the control of pH or for the calibration of pH equipment, however, the addition of sodium chloride is an inconvenience which could be dispensed with if the effect of the omission of the salt on the pH values were known.

A paper (RP 1580) by Roger G. Bates and S. F. Acree in the Journal of Research for April reports a series of electromotive-force measurements made at 5-degree intervals from 0° to 60° C on buffers of potassium *p*-phenolsulfonate and sodium hydroxide that contained varied amounts of sodium chloride. When sodium chloride was added to a phenolsulphonate buffer the pH was found to decrease. This drop could be expressed as a simple function of the amount of salt added, and it was possible to determine the pH values of similar buffers which contained no salt.

DOPES FOR AUTOMOBILE FUELS

Shortage of gasoline combined, perhaps, with the large amount of money in the hands of many motorists, has led to a great increase in the activities of purveyors of fuel "dopes," reputed to increase fuel mileage and otherwise improve the operation of automobiles.

Several of these dopes have been widely advertised, even to the extent of radio programs. Although the Bureau has tested hundreds of them in the past, both in the laboratory and in vehicles on the road, without finding beneficial results in any case, extensive tests are being completed on some of the new comers in the field to make doubly sure of the conclusions. The main conclusions as they now stand are that none of the fuel dopes used in small amounts, such as an ounce or so per gallon of gasoline, have any measurable effect, desirable or otherwise, on the operation of the automobile or the miles per gallon of fuel.

ANALYTICAL DETERMINATION OF AROMATIC HYDROCARBONS BY ADSORPTION

In a paper under the foregoing title, which appears in the April number of the Journal of Research (RP1582), B. J. Mair and A. F. Forziati of the American Petroleum Institute Research Project 6 describe a simple method of determining the amount of aromatic hydrocarbons in a mixture of hydrocarbons, as in the gasoline fraction of petroleum. The mixture to be analyzed is filtered through a column of solid adsorbent. An aromatic-free filtrate is obtained containing the paraffin, naphthene, or olefin hydrocarbon which was associated in the original solution with the quantity of aromatic hydrocarbon which has been adsorbed. The concentration of aromatic hydrocarbon in an unknown solution is determined by means of calibration curves, established from experiments on known solutions, which show the amount of aromatic-free filtrate

produced by the standard adsorbent from solutions of various concentrations of the aromatic hydrocarbon.

Results of experiments are given for several concentrations of eight binary solutions of an aromatic hydrocarbon with a paraffin or naphthene hydrocarbon and for three concentrations of a solution consisting of an aromatic hydrocarbon with a paraffin and an olefin. These experiments show that, if the temperature is controlled to within 1° C, the amount of aromatic hydrocarbon can be determined with an accuracy corresponding to 0.10 or less in the percentage by volume. A general procedure is given for determining the aromatic hydrocarbons in a "straight-run" gasoline and in a gasoline containing olefins.

SEPARATION AND RECOVERY OF AROMATIC HYDROCARBONS FROM PARAFFINS AND NAPHTHENES BY ADSORPTION

The April 1944 number of the Journal of Research contains a paper (RP1583) by B. J. Mair and A. F. Forziati of the American Petroleum Institute Research Project 6 describing a method for separating, by the process of adsorption, the aromatic hydrocarbons from their mixture with paraffin and naphthene (cycloparaffin) hydrocarbons, as in the gasoline or kerosine fractions of petroleum. The mixture is introduced into the top of a column containing an appropriate excess of solid adsorbent. A low-boiling paraffin hydrocarbon, such as pentane (or butane or propane), is then added in sufficient quantity to remove from the column the paraffin and naphthene hydrocarbons but not the aromatic hydrocarbons. The latter are then removed by adding an appropriate desorbing liquid, such as methanol. The paraffins, naphthenes, and pentane are thus obtained as a mixture from which the pentane is easily removed by distillation. The aromatic hydrocarbons are obtained as a mixture with pentane and methanol. The methanol is easily removed by extraction with water, and the pentane by distillation.

This method of separation was tested on a known mixture of 17 pure hydrocarbons, the normal boiling points of which covered a range from 60° to 174° C and included all the 5 normal paraffins from *n*-hexane through *n*-decane, the isoparaffin 2-methylpentane, the 4 normal alkyl cyclohexanes from cyclohexane through *n*-propylcyclohexane, and all of the 7 possible aromatic hydrocarbons from benzene through isopropylbenzene. The separation of the aromatic hydrocarbons from the paraffins and naphthenes was quantitative within the limits of measurement, and their recovery was complete within the normal operating loss of material in processing.

Experimental determinations were made of the quantity of aromatic hydrocarbon adsorbed per unit quantity of adsorbent, for a number of different binary solutions of aromatic hydrocarbons with paraffins or naphthenes, at several concentrations of the aromatic hydrocarbon, and with silica gel, carbon, magnesia, alumina, Filtrol, and Florisil as adsorbents. The results are displayed in the form of adsorption isotherms.

STANDARD SAMPLES OF HYDROCARBONS

In Technical News Bulletin No. 315 (July 1943) mention was made of the preparation at the Bureau of Standard Samples of hydrocarbons of known high purity for calibrating analytical instruments and apparatus in the research, development, and analytical laboratories of the petroleum, rubber, and allied industries. In order to expedite the work and to make available the largest possible number of compounds in the shortest time, only a limited quantity of each hydrocarbon has been prepared, and the purity of each has been pushed only to a point that is believed to be amply adequate for the present urgent needs for calibration. Fifteen hydrocarbons are now available, as follows:

Compound	Standard sample number	Amount of impurity
		Mole percent
n-Pentane	201	0.25 ±0.10
2-Methylbutane (isopentane)	202	.13 ±0.06
n-Hexane	203	.24 ±0.09
2-Methylpentane	204	.25 ±0.10
3-Methylpentane	205	(a)
2,2-Dimethylbutane	206	.12 ±0.05
2,3-Dimethylbutane	207	.06 ±0.04
Methylcyclopentane	208	.25 ±0.09
Cyclohexane	209	.012±0.007
Benzene	210	.05 ±0.02
Methylbenzene (toluene)	211	.04 ±0.02
Ethylbenzene	212	.20 ±0.07
1,2-Dimethylbenzene (*o*-xylene)	213	.14 ±0.05
1,3-Dimethylbenzene (*m*-xylene)	214	.17 ±0.07
1,4-Dimethylbenzene (*p*-xylene)	215	.07 ±0.03

[a] Not determined; believed to be the same as for 2-methylpentane.

Each of these hydrocarbons is available at the costs indicated, in Pyrex glass ampoules sealed "in vacuum", in the following kinds and sizes of containers:

Designation to follow Standard Sample number	Volume of Hydrocarbon	Kind of container	Cost per sample
	ml		
—5	5	Plain ampoule, sealed in vacuum.	$3.00
—8S	8	Special ampoule, with internal vacuum "break-off" tip, sealed in vacuum.	5.00
—25	25	Plain ampoule, sealed in vacuum.	9.00

Proper designation is illustrated as follows: An order for 8 ml of cyclohexane sealed in vacuum in a special Pyrex glass ampoule with internal vacuum "break-off" tip, would be given as "Cyclohexane No. 209–8S." Similarly, an order for 5 ml of 2,2-dimethylbutane, sealed in vacuum in a plain Pyrex glass ampoule, would be given as "2,2-Dimethylbutane, No. 206–5."

In the interest of simplification, the cost of the various hydrocarbons has been made the same. Prices are subject to change as conditions warrant. The cost includes delivery under Government frank in the United States and to Mexico, Canada, Cuba, and United States possessions. For all shipments to other countries, 50 cents postage must be added for each container, and, in addition, 25 cents for insurance or registration of each shipment. Samples must be paid for in advance, with order addressed to the National Bureau of Standards, Washington 25, D. C.

COEFFICIENTS OF EXPANSION OF HYDROCARBONS

Petroleum products, such as fuel oils, lubricating oils, kerosine, and gasoline, are sold by volume. The weight and therefore the amount of liquid contained in a given volume changes appreciably with temperature, for example, the amount of gasoline that fills a container at 74° F will lack about 1 percent of filling it at 60° F. In dealing with tank car and larger shipments, it is customary to measure the volume and temperature of the liquid, and then correct the measured volume to what it would have been at 60° F. To simplify the calculations, tables, such as those in NBS Circular C410, have been prepared. In computing these tables, it has been assumed that the coefficient of expansion depends only on the density of the liquid. This rule worked very well for liquids no more volatile than gasoline, but was found less satisfactory for the more volatile hydrocarbons entering into the manufacture of synthetic rubber. Examination of the data on density of the hydrocarbons listed in Letter Circular LC736 and of other volatile hydrocarbons indicated that different hydrocarbons having the same density might have considerably different coefficients of expansion, so that satisfactory tables on the old basis could not be prepared. It was found, however, that the coefficient of expansion is very nearly a single-valued function of the vapor pressure. This rule seems to work as well for mixtures as it does for pure substances.

Accordingly, a table of factors for correcting observed volumes to the corresponding volumes at 60° F has been prepared for the Rubber Reserve Co. for use in commercial transactions involving butadiene and the hydrocarbons from which it is produced. The tables give correction factors for materials having vapor pressures at 100° F. between 40 and 80 lb/in.^{2} absolute, so that, knowing the volume, density, temperature, and vapor pressure of a shipment of material, the factors to correct the volume to 60/ F or to find the number of pounds of material in the shipment can be taken from the tables.

THERMAL EXPANSION OF HIGH-SILICON CAST IRON

A paper (RP1581) by Peter Hidnert and George Dickson in the April Journal of Research gives data on the linear thermal expansion of a high-silicon cast iron containing approximately 14 percent of silicon with 3 percent of molybdenum, and of a similar iron without appreciable molybdenum, at various temperatures between 20° and 700° C. Differences between the coefficients of expansion of these high-silicon cast irons were found to be slight. Both were found to have slightly higher coefficients of expansion than electrolytic iron for temperature ranges between 20° and 300° C, and appreciably higher coefficients for higher temperature ranges. No indication of growth similar to that of ordinary cast iron was observed on heating the high-silicon cast iron to 700° C.

COMPRESSIBILITY AND RESILIENCE OF FABRICS

The compressibility of fabrics has been shown by several investigators to affect the "hand", or "feel", of the materials, particularly their feeling of softness (Technical News Bulletin No. 193, May 1933). Further studies of this property (made at the Bureau by Edwin C. Dreby during the course of a program on the development of methods for evaluating textile finishes) were sponsored by the American Society for Testing Materials. These point to compressibility as one of several physical characteristics of a fabric affecting to a large extent the judgment of hand.

The studies indicate that the compressibility between pressures of 0.05 and 0.50 lb/in.^{2} affected the judgment of the hand of the soft-finished, lightweight fabrics to which these studies were largely devoted. Therefore, a suitable apparatus for evaluating compressibility must operate at pressures within this range. The apparatus must also give reproducible results for materials having an uneven texture, similar to that of fabrics, with a minimum of time and effort. A compression meter was devised to meet these requirements. By means of the combined effects of compressed air and a column of liquid, pressure is applied to the test specimen through a very thin, pliable membrane that makes possible the application of definite low pressures uniformly distributed over a large test area. The compressibility and compressional resilience are evaluated by observing the decrease in volume of the specimen as the pressure is increased and the increase in volume as the pressure is decreased.

Studies of the compressional characteristics of a variety of cotton and rayon dress and shirting fabrics, the feel of which had been evaluated tactually by a group of textile experts, showed several ways in which compressibility is appreciated by the hands. The compressional characteristics seem to affect directly the feeling of "thickness." They likewise affect the feeling of "fullness", and it was found that the results of measurements obtained with the compression meter, when combined with measurements of flexibility, gave a quantitative evaluation of the fullness of fabrics. The measurements of fabrics thus far made with the compression meter show it to be at least as sensitive as the hands to differences in compressional characteristics and thus indicate the suitability of the instrument for evaluating the finish of fabrics.

COTTON HARNESSES FOR HORSES

The Bureau has collaborated with the War Production Board and manufacturers in developing a horse harness made of woven cotton webbing. This project was undertaken because of the acute shortage of leather, and the great need at this time for harnesses on farms in this country and abroad. Webbing to replace leather must be as strong and as flexible as the latter and must be treated to render it moisture and mildew resistant and to reduce the shrinkage to a minimum. Many types of treated cotton webbing were made up specially for this purpose by different manufacturers. Tests were conducted at the Bureau to determine such properties as strength, stretch under load, shinkage, flexibility, mildew resistance, and effect of subzero temperatures. On the basis of these laboratory tests and actual service tests at the University of Maryland, a specification for harnesses was prepared, and was issued by the War Production Board. The Office of Lend Lease has already ordered 60,000 sets of harness under this new specification for use in North Africa, and larger purchases by other agencies are under consideration.

BUILDING CODE REQUIREMENTS FOR MASONRY

On January 22, 1944, the American Standards Association approved "Building Code Requirements for Masonry," thus completing a project started at the Bureau in 1937. At that time the former autonomous ASA committee was reorganized under the Bureau's sponsorship with the title of Sectional Committee on Building Code Requirements and Good Practice Recommendations for Masonry—A41. This committee included among others, representatives of such organizations as the American Institute of Architects, American Society of Civil Engineers, American Society for Testing Materials, American Public Works Association, Building Officials Conference of America, Associated General Contractors of America, various trade associations of producers of masonry materials, and several governmental agencies. The actual drafting of the standard was the work of D. E. Parsons, J. W. McBurney, and G. N. Thompson of the Bureau, and J. H. Courtney of the ASA.

This new American Standard, designated ASA A41.1–1944, follows a middle-of-the-road course in its recommendations, which are believed to represent

minimum requirements consistent with safety predicated upon proper design and generally acceptable workmanship, but which also permit reasonable economy and some degree of flexibility.

The standard covers in detail the materials commonly used in masonry. It relates their quality to nationally recognized specifications wherever possible in order to give to the user of the standard the benefit of the great amount of technical work done by committees of national organizations in this field. A special section authorizes the building official to accept new materials and methods of construction upon a proper showing as to their suitability; the intent is to meet one of the chief criticisms of building codes, namely, that they retard and even discourage the introduction of new or improved materials not specifically covered by their requirements.

The new standard allows much wider latitude than many codes in the arrangement of units in masonry (bonding). A wide variety of combinations of units of different sizes and shapes is permissible, as well as different bonds in solid and hollow walls of brick. The attention given to requirements for cavity walls anticipates increasing importance of this type of construction after the war. The general requirement of many codes that brick shall be wetted before laying (no distinction being made between brick, the performance of which might be improved by wetting and brick for which the reverse might be true) is superseded by setting up a simple and practical method of test to cover this point.

Although the standard does not cover reinforced masonry as such, it provides for the use of reinforcement in foundation and parapet walls as an alternate method of design, thereby permitting some economy through the use of thinner walls. The practical problem of providing space for warm-air heating ducts in the walls of small dwellings, which are usually of 8-inch thickness, is recognized in the new standard by permitting chases in 8-inch walls in certain locations and under specified conditions.

This American Standard has recently been made available as National Bureau of Standards Miscellaneous Publication M174, copies of which can be obtained at 10 cents each from the Superintendent of Documents, Government Printing Office, Washington, D. C.

NEW MATHEMATICAL TABLES

The following additional mathematical tables, in the form of reprints from the Journal of Mathematics and Physics, are now available: MT23, Table of Fourier coefficients; MT24, Coefficients for numerical differentiation with central differences; MT25, Seven-point Lagrangian integration formulas; MT26, A short table of the first five zeros of the transcendental equation $J_0(x)Y_0(kx)-J_0(kx)Y_0(x)=0$; MT 27, Table of coefficients for inverse interpolation with central differences.

Copies of the above tables are obtainable at 25 cents each from the Information Section, National Bureau of Standards, Washington 25, D. C.

RETIREMENT OF DAVID E. THOMAS

David E. Thomas, dean of the Bureau's staff in point of service, will retire effective May 1. Born in Wales in 1876, he accompanied his parents to the United States when he was 14 years old and grew up in the vicinity of Wilkes-Barre, Pa., where he acquired office experience in many lines of business. His career at the National Bureau of Standards commenced on August 4, 1902, when he accepted a position as clerk in the office of the Director, Dr. S. W. Stratton. The Bureau had then been organized for only a little more than a year and had 23 employees. Mr. Thomas truly grew up with the Bureau, and from the beginning Dr. Stratton relied upon him to keep straight all matters relating to appropriations and the apportionment of funds among the different laboratories. His advice was frequently sought by the Director and division chiefs. Eventually his work was organized into the Finance Section, of which he became the head. Upon the retirement of Henry D. Hubbard in 1938, Mr. Thomas was appointed chief of the Office Division.

For 40 years Mr. Thomas has assisted the Bureau's director in presenting the annual estimates for the ensuing fiscal year before the Congress and more recently to the Budget Bureau as well. In addition, the complex work of the central office, touching every one of the Bureau's 2,300 employees, has been kept "on an even keel" under most difficult conditions.

On February 21, 1942, when the National Bureau of Standards was awarded its original "E" pennant by the Bureau of Ordnance of the Navy Department, Mr. Thomas, as senior member of the staff, was chosen to receive the first "E" lapel button in recognition of his loyal service (Technical News Bulletin No. 299; March 1942). He leaves with the esteem and best wishes of every Bureau employee.

NEW AND REVISED PUBLICATIONS ISSUED DURING MARCH 1944

Journal of Research[2]

Journal of Research of the National Bureau of Standards, volume 32, number 3, March 1944 (RP1576 to RP1579, inclusive). Price 30 cents. Annual subscription, 12 issues, $3.50.

Title page, corrections, and contents for Journal of Research, volume 30 (RP1513 to RP1544, inclusive). Free on application to the Bureau. (In TNB322 for February, an error occurs in that the title page, etc. for volume 31 of the Journal is listed as available. This notice should have referred to the title page for volume 30, as given above.)

Research papers[2]

[Reprints from December 1943 and January 1944 Journal of Research]

RP1567. pH values of acid-salt mixtures of some aromatic sulfonic acids at various temperatures and a criterion of completeness of dissociation. Walter J. Hamer, Gladys D. Pinching, and S. F. Acree. Price 5 cents.

RP1568. Axial rigidity of perforated structural members. Martin Greenspan. Price 10 cents.

RP1569. Basic ionization constant of metacresolsulfonphthalein; pH values and salt effects. Elizabeth E. Sager, Harry J. Keegan, and S. F. Acree. Price 10 cents.

RP1570. Dicalcium silicate solid solutions. Kenneth T. Greene. Price 10 cents.

RP1571. Hydrocarbons in the gasoline fraction of seven representative crudes, including all the distillate to 102° C. and the aromatics to 160° C. Alphonse F. Forziati, Charles B. Willingham, Beveridge J. Mair, and Frederick D. Rossini. Price 10 cents.

RP1572. Measurement of the refractive index and dispersion of optical glass for control of product. Helen L. Gurewitz and Leroy W. Tilton. Price 5 cents.

Circulars[2]

Supplementary list of publications of the National Bureau of Standards, January 1, 1932 to December 31, 1941 with subject and author indexes, 1901 to 1941). Supplement to Circular C24. Price 50 cents.

C445. Effect of humidity on physical properties of paper. Frederick T. Carson. Price 5 cents.

Simplified Practice Recommendations[2]

R202–43. Air compressors for automotive service stations and garages (motor-driven, ½ to 10 horsepower). Price 5 cents.

Commercial Standards[2]

CS114–43. Hospital sheeting for mattress protection. Price 5 cents.

Technical News Bulletin[2]

Technical News Bulletin No. 323, March 1944. Price 5 cents. Annual subscription, 50 cents.

MIMEOGRAPHED MATERIAL

Letter Circulars

[Letter Circulars are prepared to answer specific inquiries addressed to the National Bureau of Standards and are sent only on request to persons having a definite need for the information. The Bureau cannot undertake to supply lists or complete sets of Letter Circulars or send copies automatically as issued.]

LC743. Temperature measurements: Publications by members of the Staff of the National Bureau of Standards. (Supersedes LC688.)

LC744. Painting steel potable water tanks. (Supersedes LC337.)

RECENT ARTICLES BY MEMBERS OF THE BUREAU'S STAFF PUBLISHED IN OUTSIDE JOURNALS[2]

VHF behavior of radio components. E. L. Hall. Electronics (330 West 42nd St., New York, N. Y.) 17, 114 (March 1944).

The calory and the joule in thermodynamics and thermochemistry. E. F. Mueller and F. D. Rossini. Am. J. Physics (57 East 55th St., New York 22, N. Y.) 12, 1 (February 1944).

The Pa-Agronomico method for coagulating rubber. Felisberto C. de Cam-

[2] See footnote on following page.

argo and Norman Bekkedahl. India Rubber World (386 Fourth Avenue, New York 16, N. Y.) 109, 473 (February 1944).

Advances in plastics during 1943. G. M. Kline. India Rubber World, 109, 468 (February 1944).

The influence of plastic deformation and heat treatment on Poisson's ratio for 18:8 Cr-Ni steel. D. J. McAdam, Jr., NACA Tech. Note No. 928 (Nat'l. Advisory Com. for Aeronautics, Washington, D. C.) (February 1944) (Restricted).

Keep simplified practice working. Edwin W. Ely. Domestic Commerce (Dept. of Commerce, Washington 25, D. C.) 32, No. 3, 6 (March 1944).

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[2] Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription to Technical News Bulletin, 50 cents a year; Journal of Research, $3.50 a year (to addresses in the United States and its possessions and in countries extending the franking privilege); other countries, 70 cents and $4.50, respectively.

[3] These publications are not obtainable from the Government, unless otherwise stated. Requests should be sent direct to the publishers.

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